

Reference Condition 101

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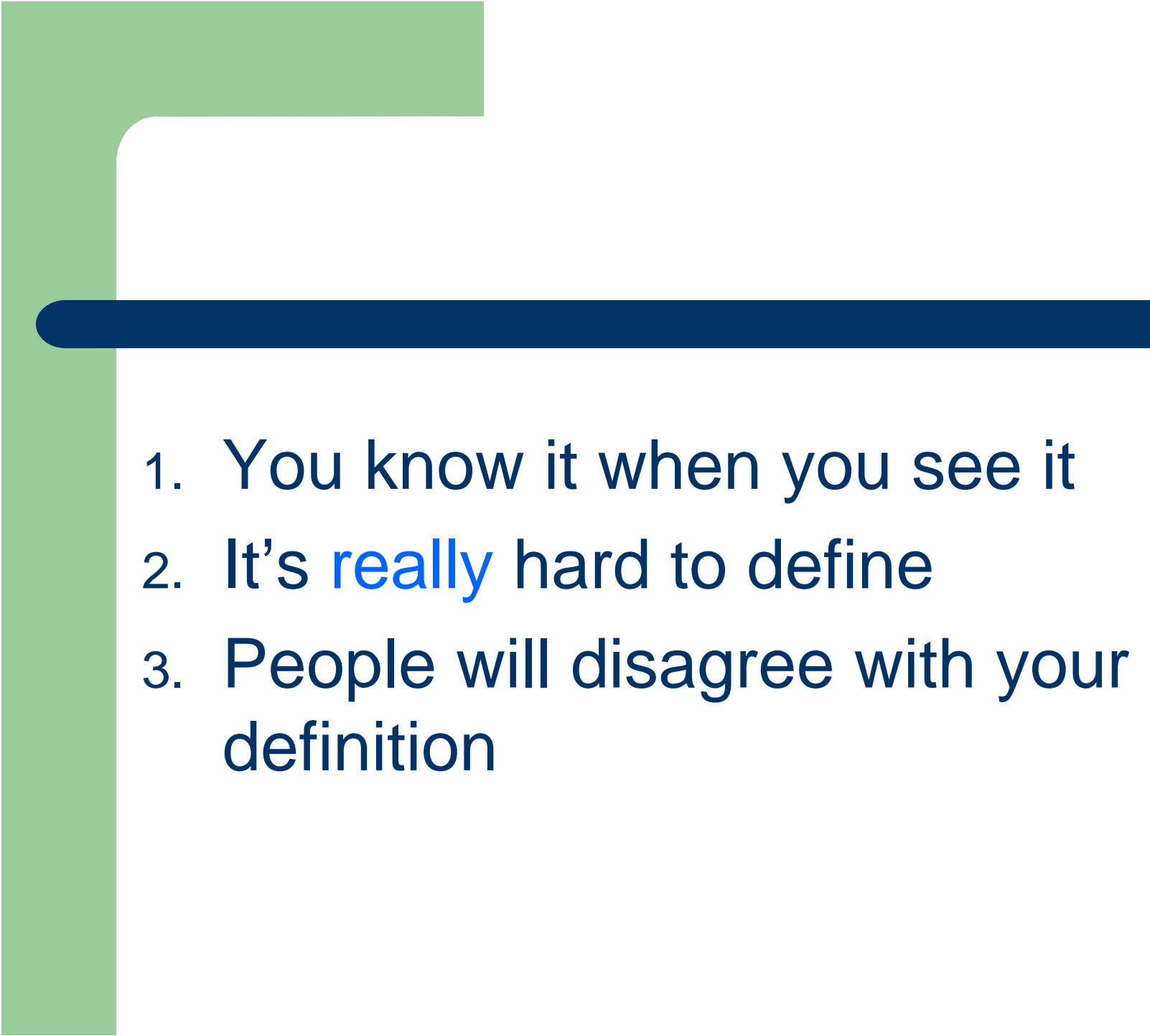
What 3 Things Do

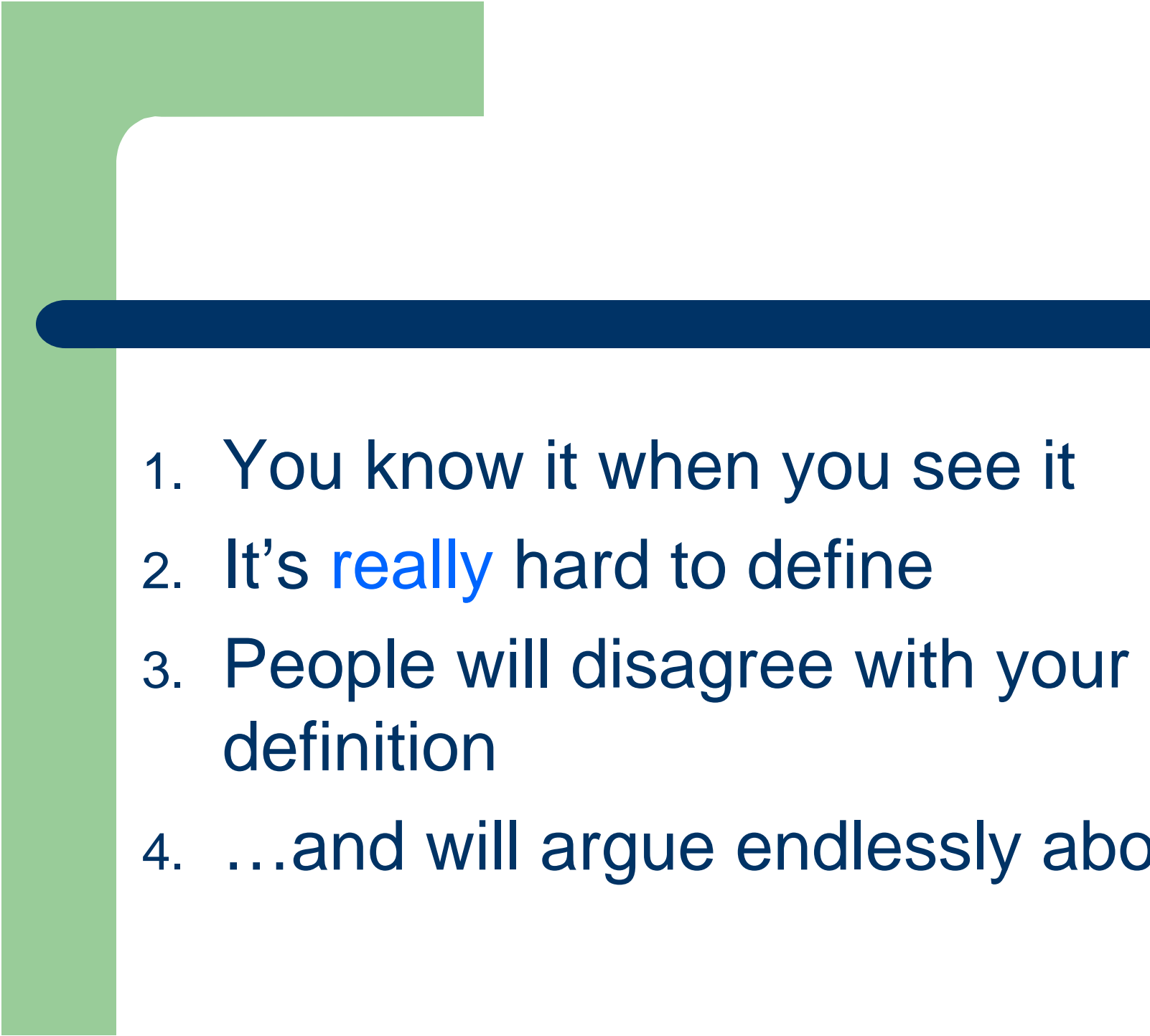
Reference Condition

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Art

Have in Common??

- 
1. You know it when you see it
 2. It's **really** hard to define
 3. People will disagree with your definition

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1. You know it when you see it
 2. It's **really** hard to define
 3. People will disagree with your definition
 4. ...and will argue endlessly about it



Definitions & Terms

Reference Site
=
Reference Condition

Definitions & Terms

Reference Site

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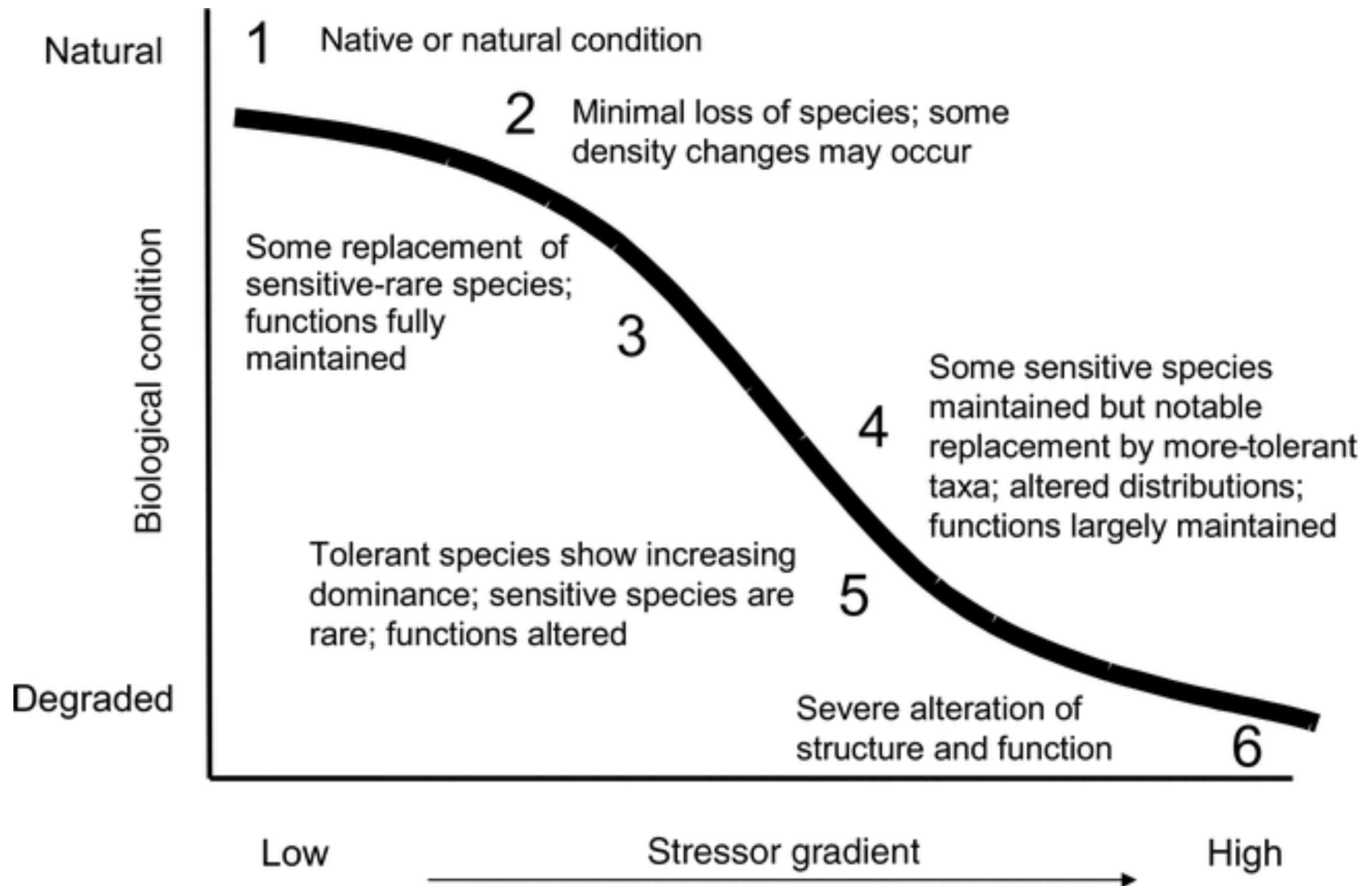
Reference Condition

Reference Condition

- Reference: a Standard or Benchmark

For a River Monitoring program

- Condition: refers to Biological Integrity (Health)
 - How Natural is the structural & functional components of the Biological Assemblage?
 - How close is the taxonomic make-up (species and numbers) to Natural?



From Davies, S.P. and S.K. Jackson. 2006. The biological condition gradient: a descriptive model for interpreting change in aquatic ecosystems. *Ecological Applications* 16:1251-1266.

Terms That Describe Reference Condition

- Pristine, Undisturbed, Natural
- Minimally Disturbed
- Least Disturbed
- Best Potential, Best Attainable
- Historic

Best Term?

- Pristine, Undisturbed, Natural
- Minimally Disturbed
- **Least Disturbed**
- Best Potential, Best Attainable
- Historic

Determining Reference Condition

- Reference Sites - Least Disturbed Sites
- Historic Reconstruction
- Modeling
- Professional Judgement

Determining Reference Condition

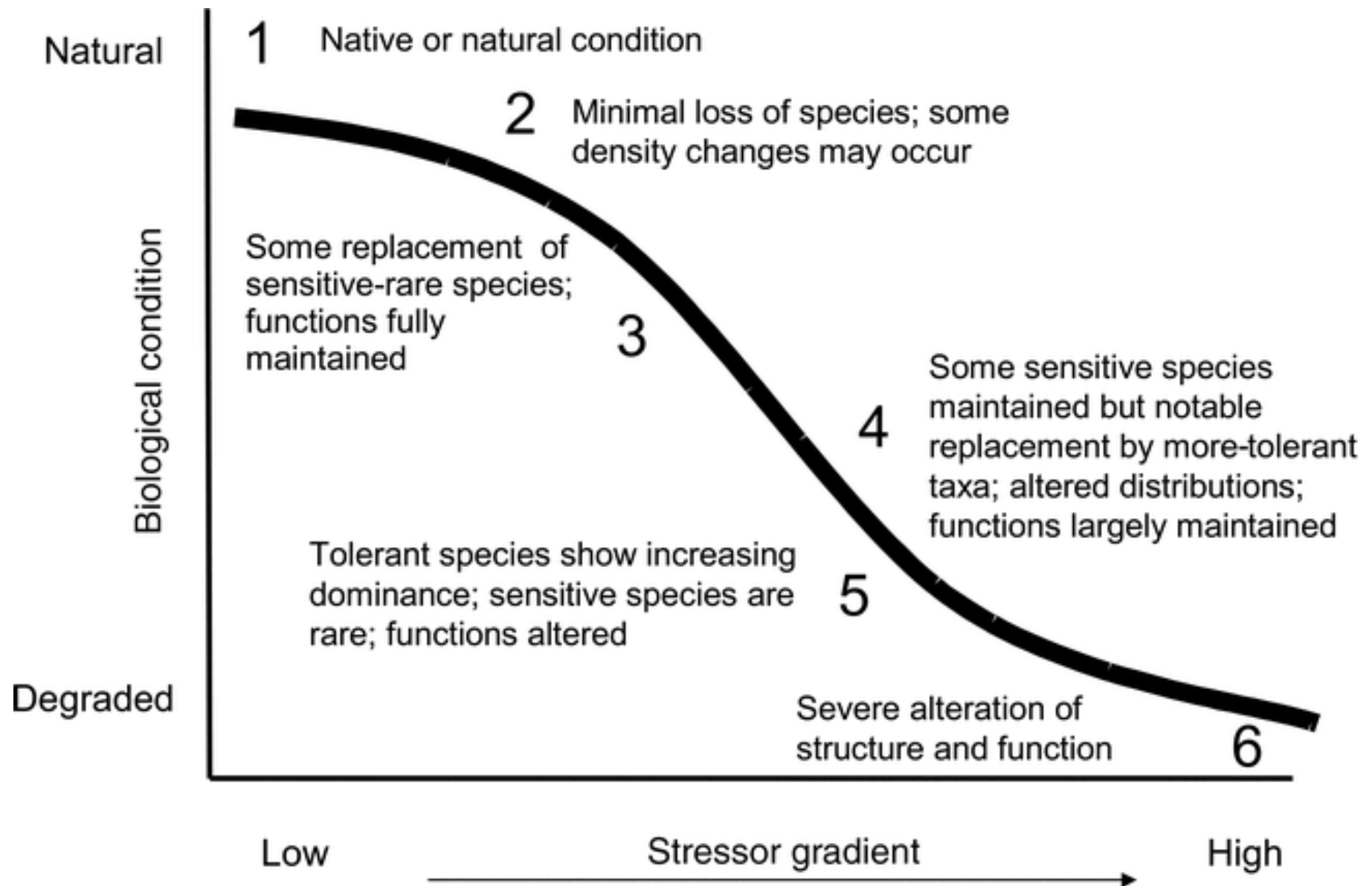
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- Historic Reconstruction
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- Professional Judgement



Selecting Least-Disturbed Sites



Issues



From Davies, S.P. and S.K. Jackson. 2006. The biological condition gradient: a descriptive model for interpreting change in aquatic ecosystems. *Ecological Applications* 16:1251-1266.

Selecting Least-Disturbed Sites Issues



The words “Disturbance Scale” &
“Least-Disturbed Sites” imply that we can
quantify Overall Disturbance

Selecting Least-Disturbed Sites Issues

- Disturbance is Multi-Dimensional
- Disturbance Measures are Context Sensitive
 - Ecological Context
 - Human Activity Context
 - Assessment Questions

Selecting Least-Disturbed Sites

Issues

- Some Disturbances are hard to measure
 - Expensive (e.g., pesticides)
 - Need long-term data
 - Lack Integrative Metrics (e.g., flow alteration)

Selecting Least-Disturbed Sites Issues

- For many streams & rivers we lack quantitative measures of what the undisturbed would have been



Do all these Challenges
Leave Us...



Selecting Least-Disturbed Sites

- Pick a variety of Disturbance Measures
- That address major kinds of Disturbance
 - e.g., Nutrients, Sedimentation, Land Use, Physical Habitat Alteration
- For which we have some understanding of their effects on Biological Integrity
- Which are routinely measured

Disturbance Measures

- Instream Chemical
 - Nutrients: Phosphorus, Nitrogen
 - Water Clarity: Turbidity
- Physical Habitat (site-scale)
 - Sedimentation: % Fines, Embeddedness
 - Riparian Vegetation Complexity
 - Visible Human Activity
- Landscape Disturbance
 - Road Density
 - % Agricultural, % Urban

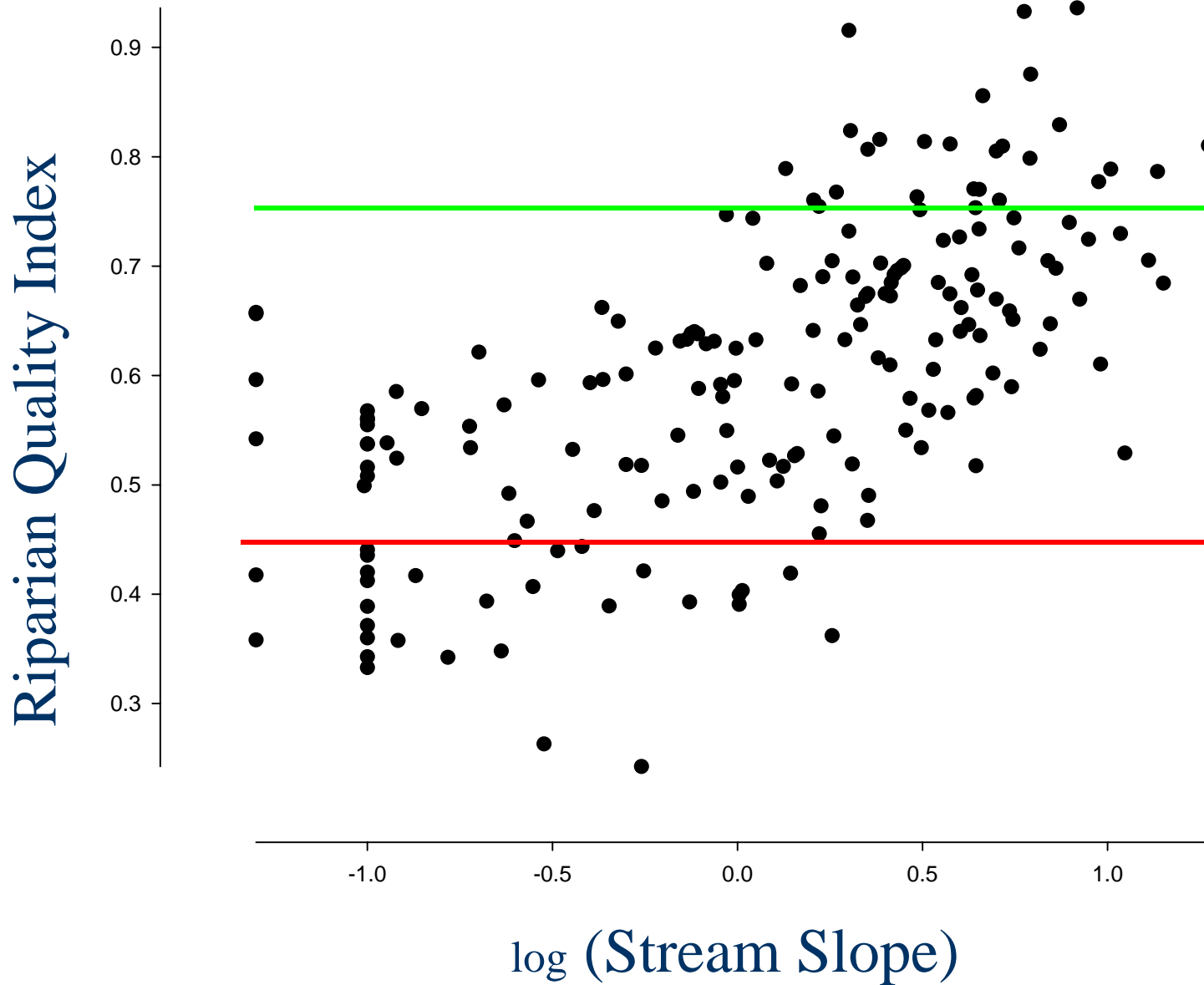
Disturbance Assessment Approaches

- Herlihy Regional Criteria Screens
 - For each Ecoregion
 - For each Disturbance Measure
 - Select a Cutoff
 - Drop any site that exceeds any Cutoff Criteria

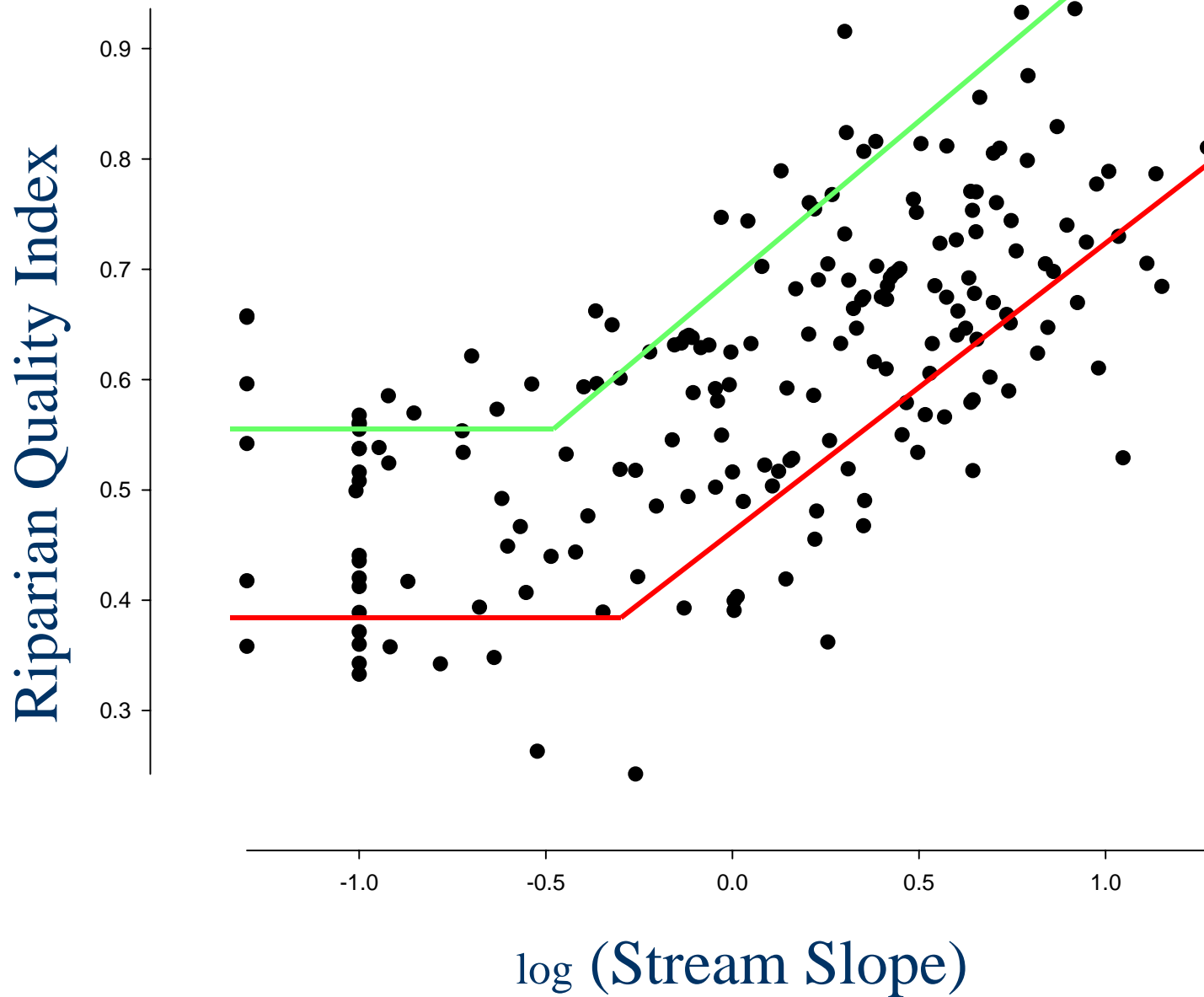
Disturbance Assessment Approaches

- Whittier Natural Gradients Screens
 - For each Ecoregion
 - For each Disturbance Measure
 - Along a major Natural Gradient
 - Select sites along Gradient with lowest Disturbance Measure values
 - Select sites with greatest number of least-disturbed “hits”

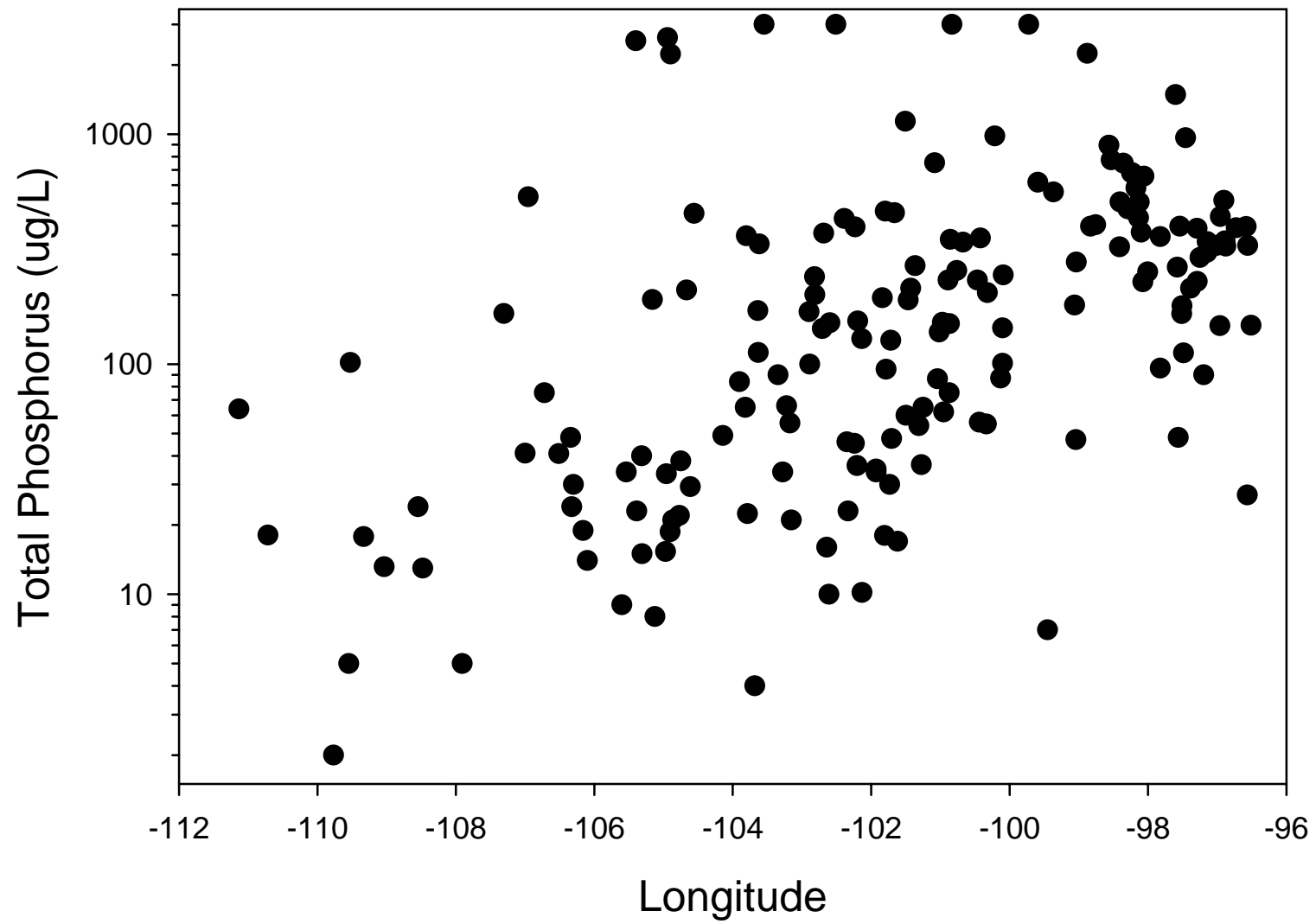
Natural Gradient & Site Quality Co-vary



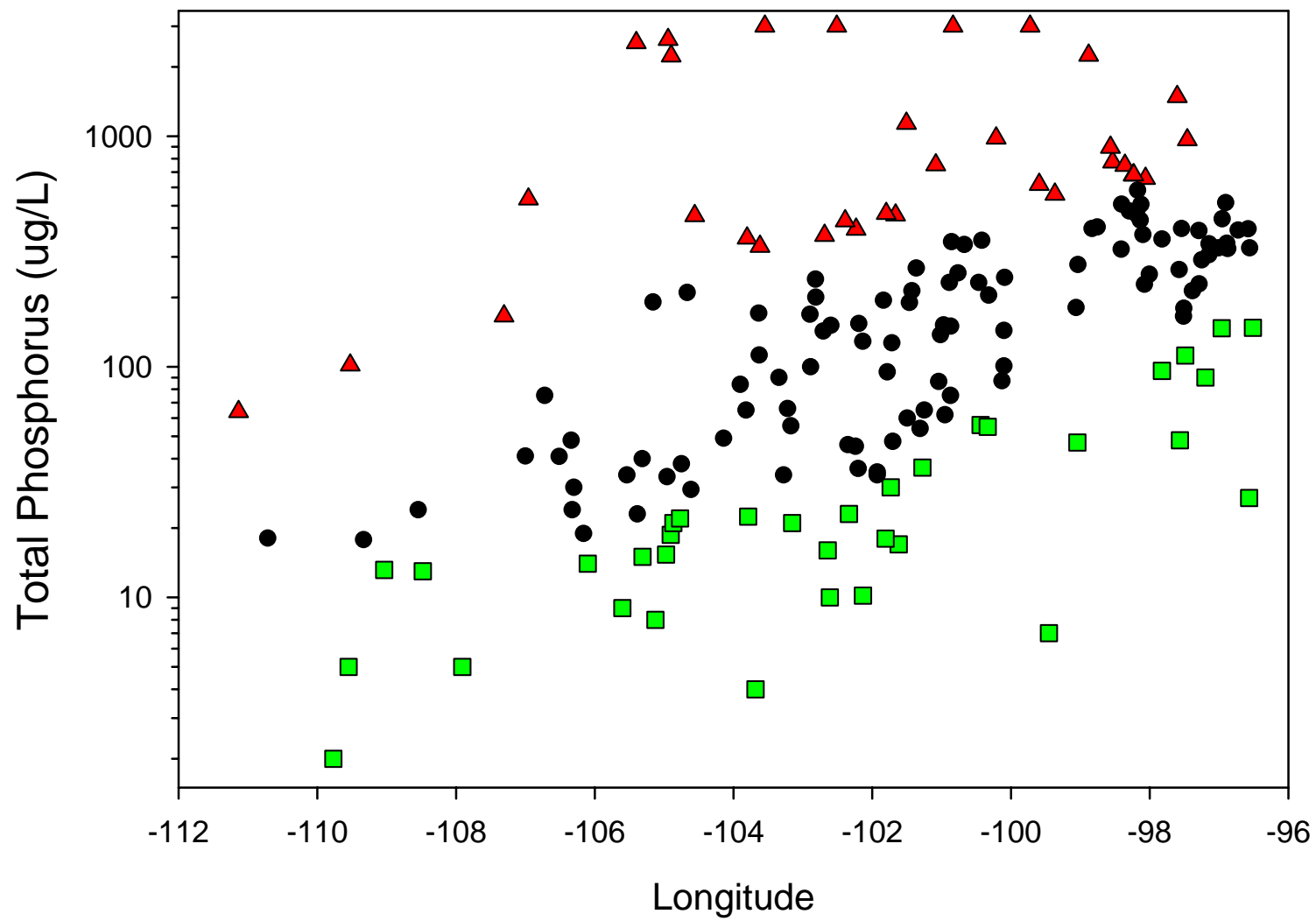
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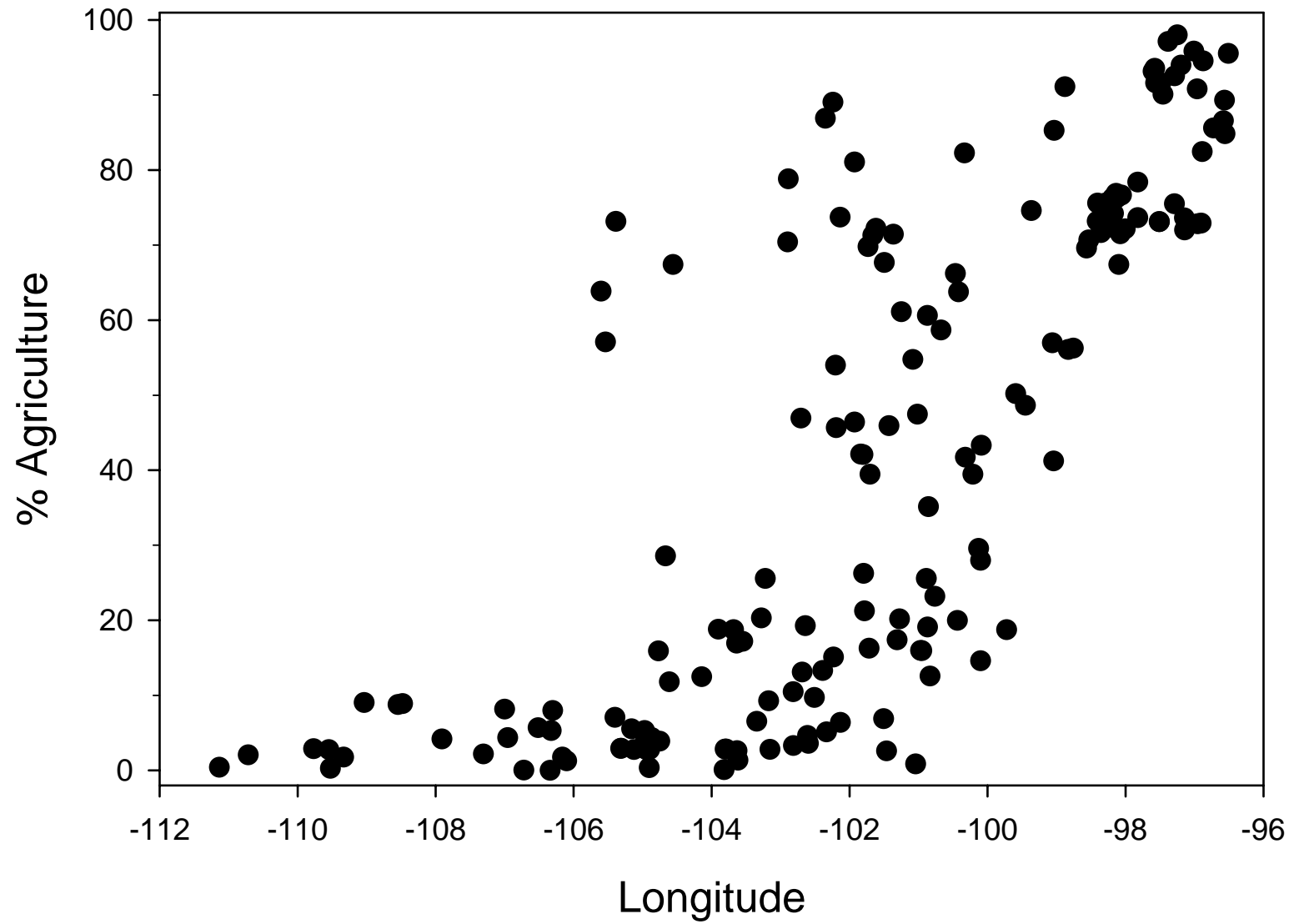
Phosphorus



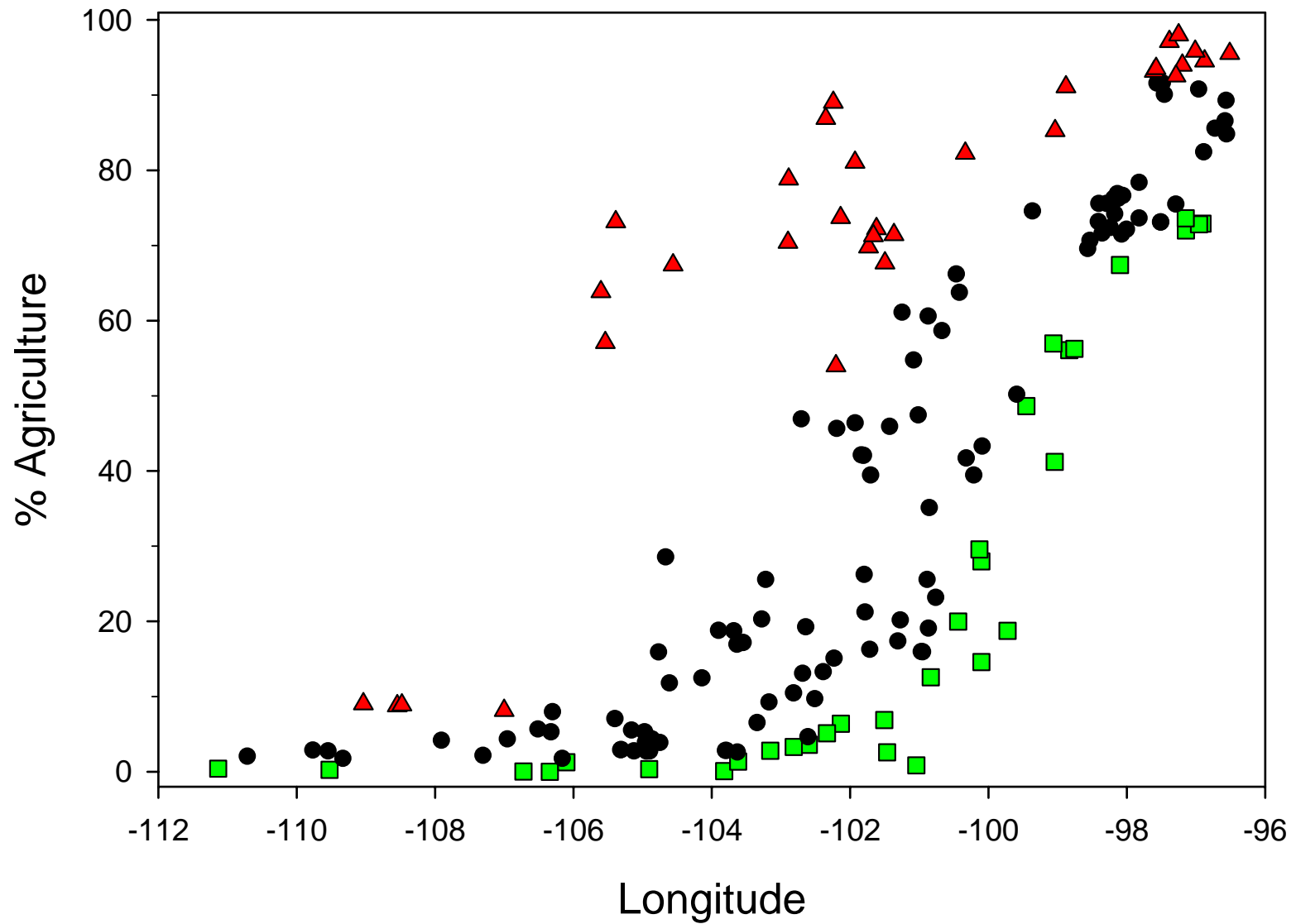
Phosphorus



Land in Agriculture



Land in Agriculture



Disturbance Assessment Approaches

- Principal Components Analysis
 - Combines multiple Disturbance Measures
 - e.g., combine Total-P, Total-N, & Turbidity into a single Nutrients Disturbance measure
 - Potentially combine a wide variety of Disturbance Measures – if they are correlated
 - e.g., in EMAP-West combined 3 Physical Habitat, 3 Landscape & 3 Nutrient/Clarity Measure which accounted for 47% of variability in PC-1

Disturbance Assessment Approaches

- “Delphi” Assessment
 - Run all of these assessments
 - Select all sites which pass all of the Assessments
 - Pitch all sites which fail all of the Assessments
 - Panel of experts evaluate in more detail sites which pass a subset of the Assessments



Other Issues

- Also Select Most-Disturbed Sites
 - Use same methods
 - Gives both ends of Stressor/Disturbance Gradient

Other Issues

- Where do you look for Least-Disturbed Sites?
 - Handpicked Sites?
 - Probability Design Sites?
 - Both?

Disturbance Class vs. Site “Origin” in EMAP West

	Least-Disturbed	Intermediate	Most-Disturbed
Probability	20.1%	58.4%	21.4%
EMAP Handpicked	35.7%	56.4%	8.9%
State Handpicked	33.8%	52.0%	14.2%

Other Issues

- The larger the river, the greater the difficulty in selecting Least-Disturbed sites
 - They experience more kinds of disturbance
 - They experience greater intensity of disturbance
 - Disturbance effects tend to accumulate downstream
 - We (all) have less experience assessing them

Other Issues

- The larger the river, the greater the difficulty in selecting Least-Disturbed sites
 - They experience more kinds of disturbance
 - They experience greater intensity of disturbance
 - Disturbance effects tend to accumulate downstream
 - We (all) have less experience assessing them
- However, these are important systems and worth the effort.